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Teaching-learning of chemistry: Analysis of representations of learners on the modeling of chemical transformation

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Abstract

A study of a sample of students in secondary education Morocco has shown that the majority of them do not have adequate representation of the concept of model or models in the scientific sense. Another fundamental problem was identified that is difficult for students to distinguish what is transformation what is reaction. Thus, an overhaul of the education system is critical to the utility implementation of learning that sets the one hand, the necessary relationship between the registry and the empirical models, and which involve other teachers by inviting them to change their own conceptions and representations and their mastery of the difficulties that students encounter on the distinction between transformation and reaction.

Keywords: education, transformation, reaction modeling.

1. Introduction

The concept of chemical change is a fundamental pivot of the teaching of chemistry. If this course does not help students build the basic concepts, it would be difficult to achieve the desired results and students are not able to identify the chemical reactions of other phenomena such as the physical transformation of matter, for example (El Hassane TOULI and al., 2011).

Modeling the chemical transformation is discussed in the Moroccan side from the class of core science and technology.

To evaluate the performances of students at this level of modeling the chemical transformation, we have submitted to a diagnostic questionnaire.

It is clear that most of the difficulties experienced by students in the teaching of chemistry are generated by non-collection of logical links between different parts of a documentary or experimental activity. The result is a poor student understanding of what is expected of them.

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2. modeling of chemical transformation in the classroom of the core scientific and technological Moroccan

Pedagogical orientations (OP, 2005) specific to this knowledge, says that one of the specific objectives of this class is to establish a material balance.

The implementation of these provisions, the chemical transformation of a system is associated with a chemical reaction that reflects the evolution of the macroscopic system and resulting in a writing called symbolic equation. However, the kinetics of evolution of the system is discussed in the first and second science class by establishing a more elaborate model involving reaction intermediates and equations. The study of chemical transformation of a system begins with the development of tools for macroscopic description of the system involving the definition of the mole.

It is then with the help of a tool - a descriptive overview of the system during the transformation - to analyze this transformation, by introducing the notion of progress, and establish a material balance. The student must be able to write the stoichiometric number of the equation in accordance with the laws of conservation of elements and loads and to understand that a chemical change does not require only that the reagents are in specific proportions in the state.

Students will be trained in the use of precise vocabulary and appropriation of convenient tools to describe and analyze a transformation, according to a progression in increasing difficulties using advancement.

The development of the material balance that the teacher does with students is essential to validate the proposed model. However, no responsibility is payable on the material balance. All of this presentation will be repeated at the beginning of the teaching of chemistry in the first science class.

Experimental illustrations are used to capture the concept of chemical change (initial and final state) and to verify the validity of a proposed model of chemical reaction to account for the evolution of a system undergoing a chemical transformation.

3. Students and modeling of chemical transformation

Although the examples of chemical change in everyday life are many, the spontaneous formation of this concept in the context of everyday life is almost impossible, because firstly it depends on an empirical scope of academic origin and secondly, the notion of chemical transformation is almost absent in both spirit and in everyday language, and so something burning, for example, is perceived more as a destruction than combustion.

These obstacles are real persistent discomfort at the unconscious level of the student and hinders the formation of concept model or modeling the concept of chemical reaction is also important in teaching than in learning chemistry.

Many studies on teaching and learning of the chemical reaction were carried out with many points of view such as the teaching of this concept (Gabel, 1998), and in particular the students' conceptions (Driver et al. , 1985; Hesse & Anderson, 1992; Nakhleh, 1992), the difficulty of students to develop the concept of chemical reaction molecular dynamics in appearance (Stavridou & Solomonidou, 2000; Gussarsky & Gorodetsky, 1990) or conceptual change (Stavridou & Solomonidou, 1998, Taber 2001; Pekdag & Marshal, 2001; Laugier & Dumon, 2000). Other research has been conducted to study the conceptual reorganization required during the construction of the concept of the chemical reaction among students (Stavridou & Solomonidou, 1998, Taber 2001; Pekdag & Marshal, 2001) and conceptual knowledge the chemical reaction during the passage of the macroscopic to the microscopic appearance (Laugier & Dumon, 2000). Other studies have been done on the reasoning and the difficulty of students to distinguish between transformation and chemical reaction, the view of teachers (Kermen, 2007) and the importance of ICT in the teaching of the chemical reaction and student learning in high school (El BILANI, 2007). However, we find that the chemical reaction is a concept that remains of great complexity implies that teachers often wrongly mastered by students.

Thus, it seems that the personal participation of the student center is almost essential to an understanding. It is therefore useful to know the recurring ideas used by students to reason. These ideas are their personal information. They build them in their heads by creating links between different concepts, forming a conceptual network, building their thoughts. These ideas are references to the explanations given by students, although they differ quite strongly conceptions of science. The designs are spontaneous thoughts. The man sees the world and analyzes the events through his own approach which often appeared logical and coherent.

Sight of their central importance in chemistry, there has been much research on the nature and use of models in science and education. What is that in recent years models and modeling have become essential in research in chemistry (Francoeur, 1997; Gilbert, Boulter, Ruthford, 1998, Rouse and Morris, 1986) is essentially a science of abstractions ("Chemistry iS Essentially a science of abstractions" Justi and Gilbert, 2006).

Therefore, chemists seek to represent the phenomena they observe (macroscopic level), to explain the ideas as events (microscopic level). For this and according to many physicists, epistemologists (Bunge, 1975; Wallisser 1977; Bachelard, 1979) and didactics (Méheut et al, 1990 and 1994; Méheut 96 and 97; Larcher et al, 1990), we consider that modeling is an essential process of science works.
Description or interpretation of a phenomenon in physics requires a model that, in general, depends on a physical theory (Bunge, 1975). The concept of model is not a single definition, this definition varies according to the scientific discipline and the term model is used by many authors with different strengths of content (Johsua and Dupin 1993). But we can say that the model would be the intermediary between what is observable (the world of objects and events) and the world of theory which is used to give an interpretation or prediction. Some educationalists have used different models to explain phenomena that subjects (students) can not understand in school learning: the particle model of gases (Meheut, 1990), the model of the world of objects / events and theory / models (Tiberghien, 1994 and 2005) and so on.
A constructivist approach to learning a concept in physics or chemistry hypothesized that students learn in a modeling activity and are related types of knowledge (Tiberghien, 1994). The advantage of this approach is that it allows students to better understand the functioning of physics and to interpret or predict the phenomena using an appropriate model.

Some educationalists using microscopic and macroscopic levels to categorize students' conceptions about a concept or a chemical phenomenon (Ben-Zvi et al. 1990; Johnstone, 1993 and 2000). Various research has been done in the interest of the modeling activity and the ability of students to link knowledge levels in the presence of a simulator (Beaufils et al. 1987; El Bilani, 2007), the thought process as Ohlson and their relationship modeling (Malkoun, 2007), on the functioning of knowledge in terms of modeling (Seck, 2007) and the knowledge brought into play in a movie watched by students term modeling (Pekdağ, 2005).

"When someone says, describes, interprets and predicts a material situation, it is in the modeling activity" (Tiberghien, 2005). The reference to the modeling process used to analyze both the knowledge taught in physics (or chemistry) and information on the behavior of students in class in physics (or chemistry) (Tiberghien and Vince, 2005). According to Marshal (1999), that the theories and models in chemistry are based on a description of the structure and properties of microscopic entities (atoms, molecules, ions) that are not observable, is a feature of the chemistry. This specificity is a source of difficulty for students who need to build a microscopic representation of matter as they only have access to macroscopic observations. To do this, it is appropriate to distinguish objects, events and properties of the perceptible world separately from non-perceptible world, consisting for example of objects such as atoms and molecules, brought into play in such events as chemical reactions ... (Marshal, 1999; Pekdağ & Marshal, 2003a). One theory has the function to interpret and predict the most phenomena through which man perceives the world (Robardet & Guillaud, 1997). It brings the law and facts in a coherent unit most often resulted in a model (Astolfi & Develay, 1998). Theories are needed in the teaching of chemistry, and essential to explain the chemical concepts, experiences, or chemical properties (Tsaparlis, 1997).

4. Operation of diagnostic questionnaire

Q1: What is a chemical change?

Some students do not apprehend the chemical phenomena such as changes in the material but as the events giving rise to effects, specific events such as a gas release, explosion or a color change ...

Other students mentioned the need of two bodies found at the start to give something else and they prove able to distinguish a chemical change a physical transformation of matter, but this distinction is not always satisfactory, for their notion body remains personal: thus they are classified body as well as long as heat or flame (for these students justified such that combustion is a chemical transformation in the presence of the flame).

Others focus on the start, they exclude from the class of chemical transformations any situation where they do not detect a body (for those students that turns milk for example is not a chemical change).

Others focus on the finish, for them the result of the chemical transformation is a new product (product in the ordinary sense of the word and not a scientific concept) (eg sweetened tea is a new product from the tea). These students perceive the changes, but based on their common sense. They made errors of assessment on the product's novelty.
There are also students that characterize chemical transformation by any unnatural changes. This opposition chemical / natural yet has been the first chapter of the chemistry of the core program of science and technology in Morocco, but the misconceptions are difficult to remove.

There are other students who consistently oppose processing and chemical reaction, but the reaction to them is far from a model.

A problem of terminology was also noted. Indeed, students do not assimilate the specific scientific language from the colloquial language, the word "products" and "mix" for example, are so widely used in every sense of the terms.

Q2: define a model and give examples that you have already met in chemistry:

The definition of a model does not seem to be considered even if the students have already encountered in school.

Some answers are correct but it often seems to be the result of pure chance. Indeed, one student can give us as a model the atom and copper.

Q3:

	YES	NO	NO ANSWER
Is it a model to explain the reality?	76	22	5
Is it a model to predict a physical phenomenon?	58	41	4
A model is still valid ?	35	64	4
A model is built through experience?	56	32	15
Un modèle est-il une construction définitive ?	34	45	24
To build a model, can we draw a pre-existing model?	65	32	6
Chemical transformation is a model?	26	46	31

The expected response is highlighted in white.

Q4: What are the steps to establish a model? The majority of students surveyed thought inductively.

For these students, the first observation. They think that to develop a model, the scientist is content to observe nature without opposing a single question. He then experiences that enable him to get out of a model.

Only two of 103 students have drafted the hypothetico-deductive. But not report the testing of hypotheses, as if scientists can not be wrong or go in wrong directions.

5. Discussion and implications

Few students have mastered the concept of chemical transformation. To remedy this deficiency, we propose to go through the approach of the modeling approach.

The challenge will be to make students understand that the chemical transformation is the process that results in the conversion of one or more other chemical species. This concept, which is expressed using concepts from other chemicals (reagent, product, chemical species, ...) is the basis of the model chemical reaction.

The concept of model as not being acquired, we propose to study with students what constitutes a model: the different concepts, the limits of the model ...

Students should also incorporate the aspect of scientific progress, notice the differences and historical breaks, understand that the driving force behind the scientific movement is the challenge, exercise critical thinking to see that particular that there is not a single scientific method. Indeed, apart from the inductive approach, widely used by teachers during their schooling, students are unaccustomed to the hypothetico-deductive yet widely used by scientists to model.

6. **Conclusion**

Although the method is inductivist have so many advantages especially the view simplicity and clarity, it is clear that such a move away from the scientific approach used in contemporary physics and chemistry. This weakness is particularly evident at the level of risk that students perceive the physical sciences as merely a series of definitions and rules for achieving the expected results.

Unlike inductivist this method, the hypothetico-deductive method is significant utility. Indeed, this latter approach does not leave any more of a simple observation but a preliminary question, a problem encountered in everyday life.

Following these thoughtful comments, assumptions are made about the causes of chemical or physical phenomenon that we must confirm or using adequate for experiments. This approach allows students to be active and to concentrate on the task under its charge. Thus, the assimilation model would be acquired by students.

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